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A Contribution to the Phytogeography and Flora of the Arfak Mountains, etc. by L. S. Gibbs

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Gibbs, L. S. "A contribution to the Phytogeography and Flora of the Arfak Mountains, etc." (Dutch N.W. New Guinea.) London, Taylor & Francis, 1917. Price 12s. 6d.

Miss Gibbs prefaces her systematic account of the plants she collected in the Arfak Mountains, situated 40 or 50 miles from the east coast of the great N.W. Papuan peninsula, with a useful description of the vegetation met with during her journey from the coast.

(1) *Beach formation of the immediate shore line.* With the exception of a few mangrove swamps and sand spits at the mouths of rivers the beach is mostly narrow, very steep and formed of large lumps of coral. "Huge trees of *Barringtonia speciosa* lie prostrate or semi-prostrate over the sea. Young plants of *Pandanus* sp., *Dracena angustifolia*, an immense *Crinum*, probably *C. macrantherum*, with giant stools of *Asplenium nidus*, no doubt displaced from the branches of the trees as they fell, crowd the ground—myriad prostrate *Barringtonia* seedlings attached by the one anchor root, all pointing seawards, bear witness to the force of the great waves retreating from their rush inland." "In many places the undergrowth is so thick or the prostrate trunks so numerous that it is easiest to walk through the surf, outside the branches of the fringing trees."

(2) *Inundation forest belt: "korang" or coral limestone zone.* "Behind the beach the low-lying belt of 'korang,' covered with forest, stretches uniformly from the coast to the foothills of the Arfak" (40 to 50 miles). This is "a sterile porous formation showing so little depth of soil that it gives the impression of walking over a reef." In 1870 Rosenberg concluded that this area is still rising and he quotes the older inhabitants as saying that they remembered low scrub where forest now stands. The rivers cut their way through alluvial deposits of mud or sand, and form great open spaces—inundation areas—sand and stones in the dry, lakes in the wet season. The entire belt is uninhabited. In the forest itself species of *Ficus*, *Macaranga* and *Artocarpus* predominate, their trunks screened by immense fronds of climbing ferns and *Epipremnopsis hugeliana*, *Raphidophora peepla*, *Philodendron* spp., *Piper forestenii*, *Pothos*, etc. Piles of the huge leaves of *Artocarpus* (1 m. by $\frac{1}{2}$ m.) accumulate under the trees to be dispersed by the floods of the rainy season. *Asplenium nidus* is abundant, but epiphytic orchids rare, and the absence of flowers and fruits striking. There is little undergrowth in the forest, sodden leaves mostly filling up the interspaces in the porous korang. The most conspicuous objects are the huge *Zanonia* capsules, the size of large pumpkins, in all stages of decay. Where there is standing water groups of Sago Palms occur, often forming swamps covering large areas. Native plantations are dotted through the forest where islands of soil accumulate or alluvial deposits have been formed by the rivers. A striking group of old *Pandanus* trees about 30 m. high was met with. Similar groups are said by the Papuans to be scattered through the forest. "These groups possibly represent the first vegetative covering of the 'korang,' displaced later by more rapidly growing dicotyledonous forest trees."

(3) *Secondary forest of the Arfak foothills (up to 7000 feet).* This is an inhabited zone with numerous *kebuns* (plantations), the ground is rocky and broken, and the forest is more varied than on the korang, both in trees and lianes, with a graceful epiphytic flora. Few species are cited by name. The cultivation consists of sweet potatoes, papaws, plantains, gourds, sugar cane, etc. with maize and tobacco as the altitude increases.

(4) *Low mountain forest above 7000 feet.* Systematic collection was limited to this formation, which is characterised by numerous conifers. The author subdivides it as follows:

(a) *Mossless Forest.* Slender straight trees 13–16 m. high with a very open, chiefly herbaceous undergrowth. **Quercus lauterbachii*, **Podocarpus papuanus* (near *P. imbricatus*)

* Endemic species.

P. rumphii (abundant), *Phyllocladus hypophyllus*, *Gleichenia linearis*, *Nephrolepis acuminata*, *Polybotrya arfakensis*, *Freycinetia gibbseæ*, *F. flaviceps*, **Alpinia domatifera*, *A. arfakensis* var. *subsessilis*.

(b) *Intermediate mossy forest.* *Dacrydium novo-guineense*, *Libocedrus arfakensis*, **Podocarpus papuanus*, *P. rumphii*, *Phyllocladus hypophyllus*, dominant, with a great variety of other smaller trees, e.g. *Drimys arfakensis*, *Spiræanthemum bellatum*, *Boeckia frutescens*, *Backhousia arfakensis*, **Idenburgia arfakensis*, **Timonius filipes*, etc. *Sphagnum novo-guineense*, *Rhacopilum spectabile*, **Dawsonia gigantea*, magnificent and abundant, with creeping *Lycopodium cernuum*, formed part of the prevailing moss carpet, from which rose abundant ground orchids including **Cryptostylis arfakensis* and *Bulbophyllum muricatum*. Among the ground ferns were *Dipteris conjugata* and *Histiopteris incisa*, and of epiphytes *Trichomanes palmatifidum*, *Hymenophyllum cincinnatum*, *Lindsaya hymenophylloides*, **Polypodium remigerum*, *P. stenophyllum*, *P. clavifer*, and the orchids *Octarrhena cylindrica*, *Dendrobium glaucoviride*, *Phreatia spathulata*.

(c) *Mossy forest.* A sterile type limited to the highest point of the ridge. The prostrate and erect trunks of the small stunted trees, with the ground between, were swathed in long moss, which stood out straight from its supports, rigidly turgid. Here were *Schizæa malacana*, *Gahnia psittacorum*, *Halorrhagis suffruticosa*, *Nepenthes maxima* var. *nana*, *Trichomanes digitatum*, *Hymenophyllum cincinnatum*, **Polypodium papuanum*, **P. remigerum* (the last four as epiphytes): also **Luzuriaga aspericaulis* and **Rhododendron angienae*.

These lists from the south-west ridge of the Arfaks give an idea of the vegetation of the different forest types. An even better collecting ground was an intermediate mossy forest forming a circular patch in the middle of the marsh of the lake basin. Along the edge which bounded the marsh was an *Araucaria*-forest with **Araucaria beccarii* predominant. Here *Araucaria* and *Libocedrus* seedlings were met with in all stages of growth, with *Dawsonia gigantea*, ferns, orchids, etc.

The open summit of Koebré mountain (9000 feet) between the two Angi lakes forms a flat plateau with a hard surface of disintegrated quartz granite. A remarkable association of *Cladonia* (*C. verticillata*, *C. didyma*, *C. coccifera*) spreads over the area as a uniform grey carpet about 3 cm. high. In places *Pteridium aquilinum*, var. *lanuginosum*, or *Gleichenia vulcanica*, and in damper places dense mats of *Centrolepis novo-guineensis* replaced the *Cladonias*. Among the associated plants were several endemic species. These open associations on the tops of mountains are apparently common in New Guinea, as elsewhere in the tropics, and are often at least due to repeated burnings. Miss Gibbs calls attention to the fact that what she calls "opportunity" plant associations of the Arfak mountains are made up of indigenous or even of endemic plants. This is in striking contrast to similar open spaces in other parts of the world, for instance in New Zealand and the Pacific islands, where such floras are commonly made up very largely of alien plants. The author considers that this difference furnishes evidence of the autochthonous character of the Papuan flora. Apart from the question of endemism the indigenous character of these ombrophobous "opportunity" associations would seem however to be the natural consequence of New Guinea "being a mountainous forest country...sparsely inhabited, with little or no inter-communication between the different tribes, and no migratory herds of grazing animals, there is everything to conserve and nothing to modify natural conditions." In such conditions, whatever the *history* of the native flora, one would expect the "opportunity" associations to be indigenous, just as when the reverse conditions obtain one would expect them to be largely alien.

Miss Gibbs produces much evidence that the Papuan flora may be regarded as a central stock from which the Malayan, Polynesian and Australian floras have been largely derived.

Endemic species.

"The flora of the mountains of New Guinea, almost unknown outside the last ten years, must now be considered the axle of a wheel of distribution, of which the spokes alone have so far been familiar to us. This is in agreement with all recent work at similar or greater altitudes. Had that axle, even now barely investigated, been worked out first, we would, as a matter of course, speak of Papuan elements in neighbouring floras, as the German and Dutch botanists have already rightly suggested."

Of 330 plants the author collected in the Arfaks 100 are new to science, with one new family and five very distinct new genera. This still further emphasises the view that Papuan forms are the original stocks from which Australian, Polynesian or Malayan species are derived. The proportion of endemism is very high in the Papuan mountains as a whole, which appear to contain an immense mass of species that may well have formed the primitive stock from which offshoots have struck into Malaya, Polynesia and Australia. Schlechter's work on the orchids of eastern New Guinea and much other recent work point in the same direction. A single case out of many given by Miss Gibbs will sufficiently illustrate what is meant. *Trimenia weinmanniaefolia* Seem. was described in 1852 from Fiji. This diœcious plant remained the type of a supposed monotypic Polynesian genus, closely allied to the diœcious *Piptocalyx moorei*, ranking as a monotypic Australian genus, till Ridley in 1916 described *T. papuana* from Mount Carstensz. *T. arfakensis* is now described, as well as a new closely allied genus *Idenburgia* with a syncarpous bilocular ovary. The position of *Trimenia* and *Piptocalyx* in the apocarpous Monimiaceæ is thus rendered untenable, and the new family Trimeniaceæ has had to be set up to include the three genera, the majority of whose known species, shewing the most primitive forms, are thus now Papuan, the two diœcious species appearing as derived.

Unlike Mr Guppy, in the book reviewed on another page, Miss Gibbs attributes great importance to the distribution of seeds by wind over great distances, and cites corroborative evidence from the great heights to which sand grains have been found to be carried. The decisive point would seem to be the existence or otherwise of ascending air currents. To distribution by winds at high altitudes the author attributes the peopling of the Australian arid regions, where the conditions favour the production of numerous closely allied endemic species from Papuan progenitors.

A. G. T.

Carey, A. E. and Oliver, F. W. "Tidal Lands, a study of shore problems."

Pp. xiv and 284, with 29 plates and 54 figures in the text. Blackie & Son, London, Glasgow and Bombay, 1918. Price 12s. 6d. net.

"This work is primarily concerned with those problems which underlie the maintenance of coastal and riparian lands, and, as a factor in such control, the extent to which horticulture may be enlisted in the cause of conservation." It is written by a "maritime engineer" (to use the apt term suggested by the authors) and a plant ecologist in collaboration, and is a pioneer example of the practical use to which the scientific study of ecology can be applied. The fusion between the work of the two authors is not ideally complete, but the book gives a thoroughly practical, informative and suggestive account of the existing methods, the causes of their frequent failure, and the future possibilities of coast protection, and of the maintenance of harbours and waterways.

Professor Oliver is responsible for rather more than half the book, and his contributions include chapters on "The Function of Vegetation," "Sand Dunes," "The Fixation and Plant Protection of Sand Dunes," "Shingle Beaches and their Fixation," "Plant Winning of Tidal Lands—Salt Marshes," and "Blakeney Point, Norfolk, from an engineering point of view." These chapters include some of the best general accounts of the three types of